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SCHOOL OF MATHEMATICS

THE EFFECTS OF GDP GROWTH RATE ON MORTGAGE INTEREST RATES IN KENYA

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DECLARATION

I declare that this project is my original work and has not been presented for a degree in any university.

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The research project has been submitted for examination with my approval as the university supervisor.

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DEDICATION

I dedicate this to my wife Margaret Kemunto, daughter Sylvia, and sons: Benjamin, Shadrack and Nelson for the Love, concern and encouragement.
I would like to thank Almighty God for giving me good health, strength and inspiration that enabled me to finish this course. I would like to thank my supervisors: Ms Caroline Ogutu, Dr. Mwaniki and Prof. Weke for their support and professional advice despite their busy schedule.

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I am grateful to my lecturers, Classmates and the entire university of Nairobi community for support and positive criticism that was instrumental in shaping this research project.
ABSTRACT
Mortgage is a long term loan that ties a prospective homeowner down to mortgage repayment for a period of 3 to 30 years or transfer of a legal or equitable interest in a specific immovable property for the payment of debt. Mortgage loans are given out with the repayment of interest and principal amount until the debt is settled. Following liberalization of interest rates, mortgage rates fluctuates very frequently to respond to change in demand and supply of loanable funds in the financial market. This study seeks to determine the effect of GDP growth rate on the mortgage interest rates variation in Kenya. The study adopted a survey research design by looking at retrospective review on GDP growth rate, and the interest rates levied on mortgage loans between 2003 and 2013. The study used secondary sources to collect data from; Kenya Bankers Association, Central Bank of Kenya and International Monetary Fund. The data was analyzed using linear regression and Pearson correlation coefficient analysis methods, conducted at 95% confidence level. The study established that there is a positive relationship between mortgage interest rates and GDP growth rate (economic growth). The study concluded that although GDP growth rate affects the mortgage interest rates, it is a weak relationship suggesting existence of other strong factors that require further investigation. The study recommended that mortgage firms should charge interest rates appropriately to attract and enable many low income earners to use mortgage facilities to mortgage market. The Government through Central Bank should initiate policy that regulate interest rates. The ultimate goal is to see many Kenyans able to take up mortgage loans at affordable rates both in urban and rural areas.
ABBREVIATION

CDF         Commonwealth Development Co-operation
GDP         Gross Domestic Product
FHA         Federal Housing Administration
FNMA        Federal National Mortgage Association
FHLMC       Federal Loan Mortgage Corporation (Freddie Mac)
NHA         National Housing Act 1938
HFCK        Housing Finance Company Kenya
TMC         The Mortgage Company
HC          Hass consult Company
IMF         International Monetary Fund
CBK         Central Bank of Kenya
LIBR        London Interbank Offer Rate.
KBRR        Kenya Banks Reference Rate.
KBA         Kenya Bankers Association.
APR         Annual Percentage Rate.
EBIT        Earns Before Interest and Taxes.
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CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

1.1.1 Definition of mortgage
A mortgage is a long term loan that ties a prospective homeowner to down mortgage repayment for a period of time; usually the period may range from 3 to 30 years. A mortgage is also a transfer of a legal or equitable interest in a specific immovable property for payment of a long term debt, (Pandey, 1999). In practice, the possession of the property remains with the borrower but the lender gets the full legal title. The borrower cannot make any modifications or even transact it without permission from the lender (Banking survey, 2002).

The mortgage loans attract some costs such as interest and transactions costs which are included in repayment of the loan. Interest rate is a percentage charged or paid by the use of the mortgage loan fund. The mortgage loan plus the cost of lending usually make mortgage properties very expensive to loan takers. On the other hand, the lenders faces risks of defaulting money lend out to customers in case of failure to pay back. The lender always seeks the historical credit profile of loan seeker before accepting to lend out the loan. Lending institutions will take into consideration the age, personal circumstances and earning capacity of the prospective borrower in order to calculate the maximum amount to be lent on an agreed period according to Apps and Goucher (1993), and Dolde (2006). The mortgage lenders in some cases use prospective homeowner’s credit history profile to calculate rate of mortgage interest and to measure the default risk. Eventually, homeowners with high risk are charged a higher interest than those of low risk (credit worthiness).

1.2. Types of mortgages in Kenya
There are two categories of mortgages offered in Kenya

1.2.1 Fixed rates mortgages
The borrower will owe a percentage of the loan as interest; the amount never changes and remains constant over the life of the loan
1.2.2 Variable /adjustable mortgage rate
In this type of loan, changes in the credit market are reflected in the repayment rates. Equal repayments are made on reducing balance and part of the interest rate risk is transferred from the lender to the borrower. This is the most preferred since it carries cheaper rates than fixed.

1.2.3 Mortgage loans tailored to specific needs;
The mortgage loans are further classified as:
- **The owner occupied residential mortgage** is a loan to purchase a property that the borrower intends to occupy as the primary home.
- **Investment residential mortgage** is a loan taken for a property considered as an investment and not intended to be occupied as a primary of the borrower.
- **Construction loan** is a facility to finance the construction of a residential property.
- **Residential plot purchase** is a product that is intended to extend money to people who want to buy a property to develop a residential house upon the plot. It is repaid within 5 years.

1.3 Mortgage market in Kenya
The development of mortgage industry in Kenya started in 1965 when the first housing finance company of Kenya was incorporated. Main objective of this company was to carry out government policy of promoting housing investment awareness and homeownership to the people of Kenya. It was to provide savings and mortgage facilities to the public. Kenya government controlled 40% of the shares and Commonwealth Development Corporation (CDC) held 60% of the share initially. In 1992, the company offered its shares to the public and it was quoted company in the Nairobi securities exchange. (Central bank of Kenya, 2002)

1. At present Housing finance company controls 29% of the total mortgages in Kenya mortgage market.

2. In 2002, banking Act was altered to allow commercial banks to lend money beyond a period of 5 years hence mortgage market received more entries, mainly from Standard Chartered Bank, Barclays Bank, Cooperative bank, Commercial bank of Africa and most recently National bank of Kenya and Kenya Commercial Bank (Central Bank of Kenya, 2011).
Report released by World Bank May 2011 showed that mortgage market in Kenya has grown rapidly over the years by both value of mortgage loans and number of mortgage loans taken. The report says mortgage assets are equivalent to 2.5% of Gross Domestic Product (GDP) of
Kenya in 2011 and is the third most developed in sub-Saharan Africa.

1.4 The threats to the development of mortgage markets in Kenya

According to survey carried by World Bank in Kenya in May 2011, it was pointed out that there are a number of constraints that affect the growth of the mortgage markets in Kenya which include, high interest rates, access to long term fund, risk management, land ownership, housing, income levels and rate of inflation. Some of these challenges are discussed below.

1.4.1 Interest rates

Interest rate is a percentage charged or paid by the use of the mortgage loan fund. The loan taker has to pay back the principal amount plus the interest charged. The interest usually varies with time. Interest rates chargeable on mortgage loans determine the mortgage quality. Higher interest rates, the more expensive the mortgage property becomes, while low interest rates means mortgage property is relatively of lower quality but is affordable. Low priced mortgage property encourages homeowners to go for what they can pay promptly. Generally high interest rates strongly discourage long term investment.

The mortgage interest rates are pushed up by many factors and are sensitive to the state of economic development of the country. Economic growth is also assessed by looking the economic indicators such as; Inflation, Consumer price index, Employment and unemployment rates, real estate development (Mudida, 2003).

Mortgage rates are also affected by the lender’s judgement. The lending institution may want to know the financial ability of the borrower by looking at his/her credit history profile. If no sufficient information about credit history is available from credit bureaus, then the lender may raise interest rate to cover the risks associated credit to the borrower. The mortgage loan is a nightmare to many Kenyans who want to buy homes or invest in mortgage properties. In Kenya less than 5% of the population is able to access mortgage loan facilities (http://www.bankrate.com/finance/financial-literacy/how-credit-scores-affectmortgagrates-1.aspx).
It is also expected that during the period of economic growth, the demand for mortgage loans is high resulting to increase of prices. The mortgage rates are lowered to slow down price increase. At the same time during economic decline prices of goods and services decline, the mortgage rate may rise stimulate growth in the economy (Mudida, 2003).

1.4.2 Effects of high interest rates

A survey carried out by the Mortgage Company (MC) in the first quarter of 2014 showed the developers of mortgage financed houses and rent them out as complete units incur loses when mortgage repayment is factored in. This has led to many unsold units of houses leading to loses on parts of the investment.

The TMC report showed that the breaker-even rate between rented income and mortgage loan repayment is 4.7%, which is far lower than 18% mortgage interests rates charged to borrowers. TMC revealed that in the six consecutive quarters from 2013 to 2014, yield remained flat on rental at 6.22% which is still lower than 18% thus making mortgage property investment a big loss to investors who rent out the units.

Factors attribute to this big loss are:-

- Enforcement of rental income tax by the government
- The high cost of building material and land especially at prime areas
- The high cost of infrastructure that adds up to between 20 to 30 % to the cost of homes.

The Hass consult company had carried a similar research and proposed the following steps to improve in lowering mortgage interest rates.

i) A need to review the building act to allow use of cost effective technologies in constructing homes using cheap materials to reduce building cost.

ii) Setting up securitization programs where financials can be obtained from the capital market. Securitization is an off-balance approach where assets are removed and sold from balance sheet of the lender to raise funds (Chiquier, Lea and Hassler,2004).This method involves significant costs and complex to set it up and administer. Nominal interest rates ranging from 20% - 30% have an influence on mortgage loans that discourage private
sector from borrowing funds to finance long term investment on mortgage properties. There is a mismatch between short term deposits and long term mortgage loans, similarly between lending and deposit (World Bank, 2013).

1.4.3 Access to long term funds
Mortgage finance institutions may lack access to long term funds to construct more properties. Mortgage market is likely to reduce or shrink in the long run due to limited funding and high interest rates. There is a need to increase Mortgage funding through mechanism such as developing secondary market. (Central Bank of Kenya, 2010)
Mortgage properties require a lot of funds to be constructed. High cost of credit and short supply of Equity in Kenya as made it difficult for developers to get loans. However the Government together with the Banks has taken some steps to control the high rising interest rates.
• The government of Kenya launched the Kenya Bank’s Reference Rate (KBRR), which is expected to guide all mortgaging and lending in the country. Standard of the offer rate means that the Central Bank Rate which was previously ignored shall be taken seriously and is a reference for all financial rates. The current KBRR stands at 9.13 % which means banks can adjust their mortgage rates by taking into account KBRR rate. Standard chartered bank has taken the lead by adjusting mortgage lending rate to 10.9 %.
• Bankers have introduced the Kenya Bankers Association’s Annual percentage Rate, which calculates the true annual cost of Borrowing, including all extra costs and charges. This rate would be the equivalent of the London interbank offer Rate (LIBR) against which all international currencies are priced.

1.4.4 Risk management and lending
Mortgage firms like other businesses have a risk associated with their investments. The level of risk and uncertainty varies in direct proportion with the period of term of the borrowed funds. Longer period of time have a higher level of risk and uncertainty (wood, 1982). Uncertainty is a situation where decision makers do not have full knowledge about the future of a product demand, factor costs and other relevant variables (Nyandemo and Singh, 2003).
Uncertainty is a state of knowledge in which one or more alternative result in a set of specific outcomes but where probabilities of the outcome are neither known nor meaningful. That is when the uncertainty is reduced to a possible outcome and alternative causes of action then it becomes a risk. Risk is a state of knowledge in which each alternative leads to one of a specific set of outcomes each occurring with a probability that is known. According to Hassler and Walley (2007) some investment characteristics are peculiar to real estate that makes it more risky than investing in government securities. Major investment risk characteristics that must be taken into consideration by investors and mortgage borrowers are interest rates, inflation and default rate risk that have already been discussed.

Lenders have inadequate information on how to capture or understand risk of borrowers; therefore a high risk premium that includes cost of defaulters is charged to customers. This problem arises because credit bureaus do not provide comprehensive credit histories of customers leading to high level of informality. High risk premiums push the prices of properties (World Bank, 2011).

1.4.5 Affordability of mortgage property
A combination of factors such as low income level, high and volatile inflation, and interest margins charged by the banks make mortgage properties unaffordable. Low level income earners who are the majority do not meet the condition requirements of mortgage loan. It is only a small number of people that can meet the conditions. These groups of people (only less 5% of the working population) usually have high income level, can access mortgage facility. (World Bank, 2012)

1.4.6 Land and housing
There is lack of affordable Housing due to high cost of building materials and cost of construction. Multiple land titling and registration mechanism in Kenya are inefficient and complex, make access to land very difficult. The cost of land together with cost of building has enormously made mortgage properties very expensive. (World Bank, 2011).
1.4.7 Rate of Inflation
Inflation is the sustained increase in the general prices level of goods and services in an economy over a period of time. It reflects a reduction in the purchasing power per unit of money or loss of real value in the medium of exchange and unit of account within the economy.

**Inflation Rate** is the annualized percentage change in a general price index (Consumer price index), it is important to lenders and investors when making decisions or purchasing loans made at fixed rate of interest over long periods of time. Any investor takes a loan when convinced that interest rate commitment is sufficiently high to compensate for unexpected loss in purchasing power during the period of inflation, therefore consensus of what investors and lenders expect inflation to be during the time that their investment and loan are outstanding is incorporated into interest rate at the time of loans and investment are made.

1.5 Problem of the statement
Mortgage loans are secured by real property. The loan taken is fully amortized with either adjustable mortgage interest rates or fixed interest. A schedule of payments of interest, and principal is provided at the time of contract. The period of payment or maturity for the term of the loan is fixed.

Mortgage financing involves the full repayment of loan borrowed to acquire the property including interest agreed upon on mortgage agreement (Chiquier, Lea, and Hassler, 2004). Many Kenyans who wish to own homes as well as property developers have complained of high interest rates charged on mortgage loans. The rising of interest rates affects the magnitude of real estate investment, tenants and home owners. Although Central Bank of Kenya reduced the base lending rates to 8.5% in 2013 but Commercial banks have continued to retain the high interest rates (TMC, 2013). This study is therefore seeking to assess the effect of GDP growth rate on Mortgage interest rates. It is achieved by determining the relationship between GDP growth rate and Mortgage lending rates.
1.6 The significance and justification of this research.
The correlation between average annual mortgage interest rates and annual GDP growth rate shall be used by mortgage finance companies and the Government to determine the future direction of mortgage interest rates. In determining the cost of investment in the mortgage sector, it’s important that the finance companies shall factor in the impact of GDP growth rate on mortgage rates. The government shall use the data in future planning for policy making concerning Mortgage investments. The mortgage developers and the Government shall use the findings to tackle the following;

- Areas which keep new housing beyond reach by majority of Kenyan population.
- To initiate secondary market that will enhance increase in funding of mortgage loans.
- Lowering mortgage interest rates in order to expand affordability. The main component of rates is the risk free rate which is determined in large part by the rate of inflation in an economy( Chris, 2008 and Hull, 2012)

1.7 Objectives
General Objective is to assess the effects of changes in annual GDP growth rate on annual Mortgage interest rates.

Specific objectives;

1. To compare GDP growth rate and mortgage interest rates of Kenya with that of USA.
2. To determine the relationship between GDP growth rate and Mortgage interest rates i
CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

England mortgage system was recognized as early as 1190 A.D. The English common law included a law that would protect a creditor by giving him an interest in his debtor’s property. It meant that although the creditor held title to the property, the debtor could in the event the debt wasn’t paid, would sell the property to receive his money.

USA, mortgages were in place as early as early 1900s. The system was brought by the Europeans settlers. Mortgage was restrictive in nature and not everybody would get it. The borrower was required to pay a down payment of 50% of the price and pays the remainder with interest. The system continued for some time and collapsed due to lack of money by both lenders and investors.

Canada by 1938, introduced the National Housing Act (NHA) and Bank Act was amended to allow Canadian Chartered banks to lend money for mortgages.

2.1 Mortgage Market in Kenya

In Kenya, Housing Finance Company of Kenya Ltd was incorporated on 18th November 1965 with an objective of carrying out the government’s policy of promoting thrift and home ownership. It was to achieve this by providing savings and mortgage facilities to Kenyan public.

HFC, Initially commonwealth Development Corporation (CDC) held 60% of equity and government 40%, currently the government owns 3.7% equity bank 24.5% BALCH 7.5% NSSF 6.8% and public 60.8% (Central Bank of Kenya, 2006).

The challenges that faces Kenya’s mortgage markets is high interest rates, lack of funding, land and real estate properties are very expensive for ordinary income earner to afford. In 2002, the government made changes in the banking act to repeal 5 year condition that restricted banks from giving long term loans beyond 5 years. Now commercial Banks have entered mortgage financial market. This was to ensure more funds are available to Kenyan public to access
mortgage funds and also to enhance development of real estate properties by mortgage companies. However the mortgage rates charged by these Banks are very high.

The government has taken a step to encourage lenders to maintain mortgage rates as low as possible to make it affordable. This has yielded fruits for example Banks like Standard chartered has maintained an average of 10.9% lending mortgage rate in the first quarter of 2014, other Banks still charge high interest rates ranging from 15% to 18% .These rates are higher as compared to those of U.S.A which range from 2.0% to 9.9%

2.2 Review of Theories

2.2.1 The Lien Theory

The lien theory states that a mortgage or a deed of trust will create a mortgage lien upon the title to the real property being mortgaged, while the Mortgage firm still holds both the legal and equitable title.

2.2.2 The Title theory

On the other hand the title theory states that a mortgage is a transfer of legal title to secure a debt, while the mortgagor still retains equitable title. In this theory, the bank is treated as having transferred title to the mortgage, subject to the mortgagee’s duty to recovery if payment is made. The title is said to remain in the borrower until the mortgage has been satisfied and foreclosed. Although the borrower has the right of possession to the property, there is generally an express agreement giving the right of possession to the mortgage firm. The mortgagee is said to hold the title for security purposes only. The mortgagor is given the right of possession (Buckely and Kalarickal, 2004).

2.3 Related researches

Many researchers have made significant progress in trying to understand factors surrounding variation of mortgage rates.

Ngacha, 2013 investigated the Effects of interest rate volatility on mortgages. It was noted in her findings that there is a positive relationship between the level of interest and default rate where
by an increase in interest rate increased non-performing loans. There was an upward rise of mortgage interest from 2007 to 2013 due to high volatility of interest rates.

**Ngumo, 2012** studied the Effects of interest rates on the financial performance of firms offering mortgages in Kenya. She noted that amount advanced by mortgage firms would lead to high financial performance (EBIT) as it increases revenue. Similarly interest rates would positively relate with financial performance till it starts to discourage borrowing owing to increase in the cost of mortgage. Finally her study recommended that mortgage firms in Kenya charge interest rates on the mortgage appropriately as ineffective interest rate policy raises the cost of mortgage borrowing.

**Muthaura, 2012** investigated the relationship between rates and real estate investment in Kenya. His findings show that the interest rates affect house prices, mostly real estate retail borrowers and investors alike are forced to increase the house prices to cater for the cost of borrowing and also break-even. He recommended that the Government to play a role control of interest rates through the Central Bank of Kenya, frequent supervision and control house pricing to protect rights of both owners and investors.

**Gerlach and Peng, 2005** examined the relationship between interest rates and mortgage credit with the application to the Hong housing market. Their result show that the increase in interest rates is positively and significantly related to growth in the long term mortgage loans.

As far as possible no study has dealt with the relationship between annual mortgage interest rates and annual GDP growth rate and to what extent it affects the mortgage interest rates.
CHAPTER THREE
METHODOLOGY

3.0 Descriptive and regression analysis
Descriptive analysis is used to show trends and comparative of mortgage interest rates and the GDP growth rates spreads. Comparison between mortgage interest rates and those of USA over the same period is included. Regression analysis is undertaken to empirically investigate the relationships between mortgage interest rates and the GDP growth rate over a period of 11 years (2003-2013).

The mortgage interest rates are those charged by the banks and the annual average for the whole of each year is taken. The annual average rate is for all the banks considered as one entity in industry and not as an individual bank rate. The research design, variables and selection of population are included.

3.1 Research design and data collection
A research design is an arrangement of condition for collection and analysis of data in a way that combines their relationship with the purpose of research. The research design adopted in this study is that the data collected is to be arranged in a form of tabulated tables. The data on GDP growth rate and mortgage interest rates considered covers the period from the year 2003 to 2013. This information was obtained from World Bank Economic Review 2013, Kenya Bankers association and the Central Bank of Kenya. The study sought to investigate the impact of growth rate on the mortgage interest rates. The trend of the GDP growth rate and mortgage rates in Kenya are shown alongside those of USA for comparison.

Main reason for selecting the period 2003 to 2013 is due to the fact that banks started offering mortgage loans from 2002. Mortgage loans are long term loans extending beyond 5 years. The banking act didn’t allow banks to give loans whose repayment extended beyond 5 years but by 2002, banking act was amended and that law was done away with. Again liberalization of interest rates had taken place, therefore forces of demand and supply would determine prices of commodities or even interest rates in an economy.
3.2 Description of Variables
The major variables taken into consideration are the period measured in years from 2003 to 2013, the annual average mortgage interest rates expressed in percentage. The annual growth rate in GDP which measures the change in the total value of goods and services produced by the country during the period of a year is another variable. Within a period of one year there can be changes in mortgage rates as well as GDP growth rate however it was necessary to take the annual average for the purpose of understanding the change that has occurred from one year to another and also to narrow down data into manageable figures for easy analysis. Mortgage interest rate was taken to be a dependent variable while GDP growth rate is an independent variable.

3.3 Description of models used in analysis of data
The data is analyzed by use of Linear Regression, Correlation analysis and standard deviation models that are explained later in this chapter. Other pricing models such as Annual percentage rate, Future Value and Capital Asset Pricing Models are discussed in this chapter however they are not for analysis purpose but to have wide knowledge on how mortgage interest rates are determined. Excel in used to compute numerical data for purpose of getting information for decision making.

3.3.1 Linear Regression model
Regression analysis determines the nature of the linear relationship between two internal variables. The GDP growth rate (\(x_i\)) and mortgage interest rates (\(y_i\)) are the variables considered in this model. Simple linear regression is a linear equation with a \(y – \) intercept and a slope which will show the connection between mortgage interest rates and the GDP growth rate.

The model is described in terms of population parameters as given in the equation below:

\[
y_i = \beta_0 + \beta_1 x_i + \epsilon_i
\]  

(3.1)
Whereby;

\( y_i \) represents a value of independent variables \( Y \)

\( x_i \) represents a value of the independent variables \( X \)

\( \beta_0 \) is the y intercept of the regression line

\( \beta_1 \) is the gradient of the regression line.

\( \epsilon_i \) is the random error or residual.

In this study the \( y_i \) values are the mortgage interest rates while \( x_i \) values are the GDP growth rate for the same year. The model assumes the following;

\[
\mu_{y,x} = \beta_0 + \beta_1 x_i \quad \text{and} \quad \mu_{y,x} \text{ is the mean of } y \text{ given } x.
\]

The value \( \epsilon_i = y_i - (\beta_0 + \beta_1 x_i) \) \hspace{1cm} (3.2)

The model has the following assumptions;

- For any given value of \( x \) and the value of \( y \) are normally distributed with a mean that is obtained from the regression line \( \mu_{y,x} = \beta_0 + \beta_1 x_i \)

- Regardless of the value of \( x \), standard deviation of the distribution of \( y \) values about the regression line is the same.

- The values of \( y \) are statistically independent of each other that are the mortgage rate for previous does not influence rate of the following year.

The values the constants in the regression are determined by use least square method described below

### 3.3.2 Least square method

The least square method is used for determining the best fit equation. The equation is given as;

\[
\hat{y} = \beta_0 + \beta_1 x \hspace{1cm} (3.3)
\]
Where the slope $b_1$ given by;

$$\beta_1 = \frac{(\sum x_i y_i) - n\bar{x}\bar{y}}{(\sum x_i^2) - n\bar{x}^2}$$

(3.4)

Where $n$ is the number of data and $\beta_0 = \hat{y} - \beta_1 x_i$.

(3.5)

A sample of the least square regression line drawn is shown in figure 2 below.

**Figure 1: Least Square Regression**

$$\beta_0 = \hat{y} - \beta_1 x$$

(3.6)

### 3.3.3 The standard error estimate

Errors arise when using a regression formula due to the fact that not all data or points are on the line hence a need to calculate what is known as standard error of the estimate. The computational formula for standard error estimate is given as;
\[ S_{yx} = \sqrt{\left(\sum y_i^2 - \beta_o(\sum y_i) - \beta_1(\sum x_i y_i)\right)} \]
\[ n - 2 \]  

(3.7)

\[ n = \text{Is a number of data points} \]
\[ \beta_o = \text{Is the y – intercept shown by the sample regression line} \]
\[ \beta_1 = \text{Is the slope of sample regression line} \]

The mean of y given value of x calculated using regression equation is subjected to confidence interval that is the basis under which the value is accepted or rejected. The formula for confidence interval for mean of y given a specific value x is;

\[ \hat{y} \pm t S_{yx} \sqrt{\frac{1}{n} + \frac{n(x - \bar{x})^2}{n\sum x^2 - (\sum x)^2}} \]

(3.8)

Where;
\[ \hat{y} \] is the estimated value of y for the given value of x
\[ n \] is the number of data points
\[ S_{yx} \] is the standard error of estimate
\[ t \] is t-value for confidence level desired and
d.f= n-2 (degrees of freedom)
\[ x \] is the value equal to the given value of xi

3.3.4 Standard deviation model

It is important to note that standard deviation is used to assess the volatility of the mortgage interest over a specified period in time. Similarly it can be shown that volatility of the mortgage interest rates corresponds to changes in GDP growth rate, discussed later in the study. Volatility is the ability to change i.e. (rise or fall) in interest rates within a certain period.
In the property market, traders are keen on this volatility of mortgage interest rates which are likely to affect the demand and supply in the economy. Standard deviation is a measure of volatility and it is depended on the period or length of loan term in consideration. If calculated on a year basis, then the formula used is given as

\[
\delta = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}} \quad (3.9)
\]

Where

\( \delta \) is the standard deviation
\( x \) is the mean rate in a year
\( x_i \) are the observed interest mortgage rates
\( n \) is equal to 12 months the period under consideration

Standard deviation is simple to calculate since information is easily available. It is based on historical data, therefore it may not give the true picture of the future rates especially for long term investments.

### 3.3.5 Correlation analysis

This method measures the strength of the linear relationship between the variables. The method involves two measures

i. The coefficient of correlation

ii. The coefficient of determination

#### 3.3.6 Coefficient of correlation (r)

It is a number that indicates both strength and direction of the relationship between independent variables \( x \) and independent variables \( y \). When \( r \) is positive, \( x \) and \( y \) are directly related and when \( r \) is negative, \( x \) and \( y \) are inversely related. Values of \( r \) ranges between \( r =1 \) and \( r = -1 \). If the absolute values of \( r \) is large, the stronger the relationship and small shows a weak relationship and when \( r = 0 \), slope of regression line is zero and there is no relationship at all.

The formula for coefficient of correlation is given as;
\[ r = \frac{n(\sum x_i y_i) - (\sum x_i)(\sum y_i)}{\sqrt{n(\sum x_i^2 - (\sum x_i)^2) \times \sqrt{n(\sum y_i^2 - (\sum y_i)^2)}}} \] 

3.3.7 Coefficient of Determination

It measures the strength of the relationship, \((r^2)\) and it given as;

\[ r^2 = 1 - \frac{\sum(y_i - \hat{y}_i)^2}{\sum(y_i - y)^2} \]

\[ r = 1 - \frac{\text{SSE}}{\text{SST}} \]

Where;

\[ \sum(y_i - \hat{y}_i)^2 \] is error in variation which is not explained by the regression line

\[ \sum(y_i - y)^2 \] Total variation in y – values by the regression line

3.4 Determining mortgage interest rates

3.4.1 Annual Percentage Rate Model

Mortgage interest rates can be determined using various interest rate models.

Annual percentage rate model (APR). Also known as internal rate of return to mortgage lenders or discount rate that equates future stream of cash with the present value of that stream.

In the case of home mortgage, the formula applied is;

\[ L - F = \frac{P_1 + P_2 + \ldots + (P_n + \beta_n)}{1+ i \ (1+i)^2 \ (1+i)^n} \]

Where;

\( i \) is Internal Rate of Return
L is the loan amount
F is the points and other lender’s fee
P is the monthly payment
n is the month when the balance is paid in full.
\( \beta n \) is the balance in the last month

The value of i represents internal rate of return to the mortgage lender. It is obtained by a series of successive approximation or use of the computers. This model assumes that:

- The loan runs to the end of the term n, and \( \beta n = 0 \)
- If insurance premiums are charged on mortgage, the monthly premium is included in P and balance must exceed 78% of the original property value
- In case of upfront premium, it is included in F and if financed then P is calculated based on larger amount of loan. L doesn’t include premiums.
- The index remains unchanged over the life of the loan.

### 3.4.2 Future value model

The future values of a series of payments of equal size, starting after one period is

\[
FV_n = P(1+i)^n
\]  

Where P is the period payment
\( FV_n \) - Is the value of the single sum after n periods.
  * i - is the amount of the single interest.
  * n- is the length of the period of payment
The value i again can be determined by use a computer.

### 3.4.3 Capital asset pricing model

It is used to determine the mortgage rates at which the assets are priced. The model incorporated the return for the investment and the risk associated with this investment in the property market. The model assumes the following
• The investors have same one period horizon for example 15 years, 20 years or 30 years so that the model is applied uniformly by all participants in the market.
• Investors in the property market can borrow or lend unlimited amounts of the same risk free rate
• Risk property markets are perfect i.e. information is freely and instantly available to both investor and non-investors.
• Property market investors measure in the same currencies dollars or shillings.
• Investors have same expected returns, standard deviations and covariance of securities over a period of time by applying capital market line, equation of the expected rate of return on property investments is given as

\[ E_p = r + (E_m - r) \frac{\delta p}{\delta m} \]  

(3.14)

\( E_p \)- represents expected return on the investments, p equivalent to mortgage interest rate.
\( E_m \)-represents return on the market investment taken
\( \delta p \)- represents standard deviation of the return on the investment P taken.
\( r \) - represents the risk free rate of return associated with this investment

This model can be used to estimate the future mortgage interest rates by taking into consideration the GDP growth rate and other factors that influence the interest rates. In the above model, the market free risk rate is equal to the gradient of the capital market line in the expected return versus standard deviation space sp graph shown below. (Fig 1)
Point M shown on the graph is point where the investors are likely to get optimum rate of return $E_m$, and at this point the efficient frontier and capital market line meet.

The advantage of the model is that it incorporates risk associated with asset to determine the approximately value of the mortgage interest rates at a given period of time.

### 3.5 GDP growth rate

- Gross domestic product (GDP) is the value of goods and services a country produces during a specific period of time usually 1 year.
- GDP growth rate is the growth on an annual basis adjusted for inflation and expressed as a percentage.
- GDP growth rate is one of the economic indicators of the country’s economic wealth. It is expressed as a comparison to previous year or quarter, for example if the GDP growth rate went up in the current year from previous year by 4% it means economy has grown by 4% over the last year.
- As mentioned earlier in this study, the changes in GDP growth rate as an effect on the mortgage interest rates. The relationship between GDP growth rate and mortgage interest rates is assessed using the regression and correlation analysis.
3.6 Summary

All types of real estates are secured with mortgage and bear an interest rate that is supposed to reflect the lenders risk. Mortgage lending is the primary mechanism used by many countries to finance private ownership of residential and commercial property, therefore interest rates are viewed as a risk to mortgage firms and care must be taken. This study seeks to establish the relationship between these changes in mortgage interest rates and GDP growth rate.
CHAPTER FOUR

4.0 Data analysis, Results and Discussion

This chapter presents analysis and findings of the research in two categories thus descriptive analysis and empirical results.

4.1 Descriptive analysis

Table 1 below shows the annual average mortgage rates for 15 years old contract charged to ownership in Kenya and U.S.A in comparison from 2003 to 2013.

Table 1. Annual avg. Mortgage contract rates for 15 year old for Kenya and U.S.A expressed in %

<table>
<thead>
<tr>
<th>Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kenya</td>
<td>19.5</td>
<td>19.0</td>
<td>12.0</td>
<td>13.0</td>
<td>13.5</td>
<td>13.9</td>
<td>14.0</td>
<td>14.0</td>
<td>15.0</td>
<td>20.0</td>
<td>19.5</td>
</tr>
<tr>
<td>U.S.A</td>
<td>5.69</td>
<td>5.67</td>
<td>5.86</td>
<td>6.52</td>
<td>6.46</td>
<td>7.95</td>
<td>5.06</td>
<td>4.79</td>
<td>4.55</td>
<td>3.70</td>
<td>3.86</td>
</tr>
</tbody>
</table>

As evidenced by the data shown in the table home ownership in Kenya, rates are extremely high as compared to U.S.A over the same period of time. In the U.S.A the government had to intervene by making changes to mortgage sector so that rates are kept low for the public to afford. For example those seeking to buy property were often required to pay a down payment of 50% but were later on done away with when it became expensive to buy property. The government also established corporation that would provide funds to mortgage institutions.

Similarly in Kenya, housing finance company was formed to facilitate home ownership to the Kenya public however still the mortgage sector faces a lot of challenges due to high interest rates as compared to USA. It is cheaper for an ordinary America to afford a mortgage facility in the USA than an ordinary Kenya to afford such a facility in Kenya.
Table 2 Below shows the Mean, Variance and Standard deviation of mortgage rates.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>KENYA</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of population</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Mean $\bar{y}$</td>
<td>15.76364</td>
<td>5.465</td>
</tr>
<tr>
<td>Variance $\delta^2$</td>
<td>9.35454</td>
<td>1.425</td>
</tr>
<tr>
<td>Standard deviation $\delta$</td>
<td>3.05852</td>
<td>1.194</td>
</tr>
<tr>
<td>Minimum rate</td>
<td>12.0</td>
<td>3.70</td>
</tr>
<tr>
<td>Maximum rate</td>
<td>20.0</td>
<td>7.95</td>
</tr>
</tbody>
</table>

Again from the table 2 above there’s evidence that the mortgage rates in Kenya (3.05852) are more volatile than those in USA (1.194). The minimum and maximum rates of Kenya are almost thrice those of USA as in the table. There is some evidence to argue that mortgage interests rates are very high in Kenya in comparison with USA.
Comparison is further shown in fig 3 below.

Fig 3 Annual Av. Mortgage Contract rates for 15 year old for Kenya and U.S.A expressed in %

ANNUAL AVERAGE MORTGAGE CONTRACT RATES
The GDP growth rate table 3 below shows how it has been varying from 2003 to 2013. The figures shown are the actual and not the projections.

**Table 3; GDP of Kenya and USA.**

<table>
<thead>
<tr>
<th>Years</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual GDP growth rate % for Kenya</td>
<td>2.785</td>
<td>4.616</td>
<td>5.981</td>
<td>6.326</td>
<td>6.993</td>
<td>1.528</td>
<td>2.685</td>
<td>5.52</td>
<td>3.4</td>
<td>5.2</td>
<td>4.6</td>
</tr>
<tr>
<td>Annual GDP growth rate % for U.S.A</td>
<td>6.42</td>
<td>6.31</td>
<td>6.52</td>
<td>5.12</td>
<td>4.40</td>
<td>-0.92</td>
<td>0.11</td>
<td>4.56</td>
<td>3.64</td>
<td>3.47</td>
<td>4.57</td>
</tr>
</tbody>
</table>


It is evidenced from fig. 2 that Kenya experienced a big decline in GDP in the year 2008 and 2009 mainly due to political instability (post election violence). Further GDP graph is shown in fig 4 below.
4.2 Results and discussion.

The study conducted inferential analysis using;

- Regression analysis
- Anova/standard deviation
- Least square method
- Pearson correlation coefficient

Regression analysis and least square were used to measure direction and strength of relationship between individual independent variables and the dependent variables. The dependent variables are the annual average mortgage rates of a given year and the independent variables are the annual GDP growth rate. Anova was used to test the gradient Bi of the regression line. Pearson
correlation was used to test linear dependence or association between changes in annual average mortgage rates and changes in Annual GDP growth rate.  

From R application we have the following:  

Coefficients:  

<table>
<thead>
<tr>
<th>Intercept</th>
<th>slope $\beta_1$</th>
<th>mean of y 15.76364</th>
<th>Sd of y 3.05852</th>
<th>mean of x 4.512182</th>
<th>Sd of x 1.71968</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.526</td>
<td>1.604</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Mean and standard deviation of annual average mortgage rates and annual GDP growth rate

<table>
<thead>
<tr>
<th></th>
<th>Mean %</th>
<th>Standard deviation %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual average mortgage rates</td>
<td>15.76364</td>
<td>3.05852</td>
</tr>
<tr>
<td>Arrival GDP growth rate</td>
<td>4.51218</td>
<td>1.71968</td>
</tr>
</tbody>
</table>

The standard deviation measures the volatility of both mortgage interest rates and GDP growth. It shows that mortgage interest rates (3.05852) are more volatile as compared to GDP growth (1.71968).

- Regression live is determined by obtaining the values of the consults in the following equation:

$$ y_i = \beta_0 + \beta_1 x_i $$  \hspace{1cm} (4.1)

The specific regression equation obtained is:

$$ y_i = 8.526 + 1.604x_i $$  \hspace{1cm} (4.2)

Where $y_i$ represents annual average mortgage rates and $x_i$ represents annual GDP growth rate.
To obtain the value of $\beta_0$ and $\beta$, the following were assumed to hold:

- For any given value of $x_i$, $y_i$ is normally distributed and has expected value on the regression line.
- Regardless of the value of $x_i$ the standard deviation of the $y$-values about the regression line is the same.
- The $y$-values as statistically independent to each other.

### 4.3 Calculating Standard Error

Not all points may fall on the regression line; therefore there is a need to calculate standard error of the estimate given as:

$$S_{yx} = \sqrt{\frac{\sum y_i^2 - b_0(\sum y_i) - b_1(\sum x_i y_i)}{n - 2}} \tag{4.3}$$

From table 1 previously given the value of $S_{yx}$ is 1.1732

Note that the larger the value of $S_{yx}$ the larger the amount of scatter in the data from the regression line. In this case standard error reflects a larger amount of scatter since its value is large.

When every point in the scatter fall on regression line, the standard deviation is expected to be zero thus a strong relationship between the two variables (dependent $y_i$ and independent variable $x_i$)

### 4.4 Confidence interval for the mean of $y$ given value of $x$

A value of $x$ closer to the mean of $x$ chosen and confidence internal for the mean of $y$ is determined as follows;

Let $x = 15.0$ nearer the mean of $x_i$. 

The confidence interval for the mean of $y_i$ at 90%, 95% and 50% using equation 13 is summarized as shown in the table 5 below;

**Table 5: Confidence interval**

<table>
<thead>
<tr>
<th>Confidence level</th>
<th>t-total value</th>
<th>Confidence limits %</th>
</tr>
</thead>
<tbody>
<tr>
<td>90%</td>
<td>1.833</td>
<td>4.711% and 26.365%</td>
</tr>
<tr>
<td>95%</td>
<td>2.262</td>
<td>2.176% and 28.9%</td>
</tr>
<tr>
<td>50%</td>
<td>703</td>
<td>11.385% and 19.691%</td>
</tr>
</tbody>
</table>

The results show that at 95% confidence level, the range of $x_i$ values is larger than when 50% confidence level is taken. This is due to the fact that 95% confidence has a larger area of the distribution used than 50%. In the distribution table 1 of the mortgage interest rates, values range from 12% to 20% hence 50% confidence interval looks more realistic than 95% level but not acceptable in predicting future variations with high degree of exactness.

**4.5 Hypothesis testing of the $\beta_1$ value**

($\beta_1$ is the gradient of regression line)

The null hypothesis: $\text{Ho}: \beta_1 = 0$

Alternative hypothesis $\text{H}_1: \beta_1 \neq 0$

The value of $\beta_1$ is zero if there is no relationship between mortgage interest rates and GDP growth rate but if $\beta_1 \neq 0$ then there is a relationship between the independent variable $x_i$ and dependent variable $y_i$.

The rule is that we accept $\text{Ho}$ if it is proved that $\beta_1 = 0$ and reject the alternative hypothesis $\text{H}_1$.

The value of $\beta_1 = 0$ is not true, what is confirmed is actually $\beta_1 \neq 0$ but is 1.604. This means there is a relationship between mortgage rates and GDP growth rate, therefore there is
sufficient information to reject Ho and accept the alternative hypothesis H₁. It is important to test the significance of β₁ value using the test distributions and correlation coefficient and determination to ascertain the strength of the relation.

4.6 Correlation analysis results and significant test.
The correlation coefficient r, and coefficient of determinations r² results obtained from R-application are summarized in the table 6(a) and 6(b) below.

Table 6a (Significance Test from R-application)
Data mortgage interest rates (A) and GDP growth rate (B)
\[ t = 6.2637, \text{ df} = 9, \text{ p-value} = 0.0001472 \]
Alternative hypothesis: true correlation is not equal to zero
95% confidence interval: 0.6580187  0.9745261
Sample estimates: cor 0.9018912

Table 6 (b) Rank Correlation Coefficients/Determination

<table>
<thead>
<tr>
<th>n (degrees of freedom)</th>
<th>r</th>
<th>r²</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>0.9018912</td>
<td>0.0079</td>
</tr>
</tbody>
</table>

Indeed, the value of \( r = 0.9018912 \), it shows that mortgage interest rates (yi) and GDP growth rate (xi) are positively related. This was also reflected on the regression line where the slope was positive. It translates to that an increase in growth rate of GDP; there is a slight increase on mortgage interest rates. Usually a strong relationship is where \( r = -1 \) or \( 1 \), however value of \( r \) is for much smaller showing a weak relationship. The fact that volatility of annual (average) mortgage interest rate is very high, the results suggest that there might be other factors that influence the rates more than the GDP which need to be investigated.

Again the value of \( r² = 0.0079 \), it means that 0.79% of the variation can be explained on the regression line. Thus 99.21% cannot be explained from the regression line. The figures show a very weak relationship, meaning there are other factors which influence mortgage interest
rates strongly than GDP. The variation in y-values according to coefficient of determination as shown by the regression line.

\[ \text{SSR} = \text{SST} - \text{SSE} \]  \hspace{1cm} (4.4)

\[ = 78.3275 - 78.26545. \]

\[ = 0.06205 \]

Where;

SST = Total variation in y – values.

SSR = Variation explained by regression line.

SSE = Variation not explained by regression line.

The result shows a very small proportion of variation is explained by regression line. The combined summary shows that the value \( \beta \) is greater than zero; the relation is insignificant according to the summary report below.

Coefficients:

<table>
<thead>
<tr>
<th></th>
<th>Estimate std</th>
<th>Error</th>
<th>t value</th>
<th>pr (&gt;lt l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>8.5259</td>
<td>1.2294</td>
<td>6.935</td>
<td>6.8exp (-0.5)</td>
</tr>
<tr>
<td>B</td>
<td>1.6040</td>
<td>0.2561</td>
<td>6.264</td>
<td>0.000147</td>
</tr>
</tbody>
</table>

Signif.codes 0 ‘***’ 0 001 ‘**’ 0.01 ‘*’ 0.05 ‘’ 0.1 ‘

Residual standard error: 1.393 on 9 degrees of freedom

Multiple R-squared: 0.8134, Adjusted R-squared: 0.7927

F-statistics: 39.23 on 1 and 9 df, p-value 0.0001472

Where:

A represents data for mortgage interest rates,

B represents data for annual GDP growth rate.
CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

5.1 Introduction
This chapter presents the key findings presented in data analysis, and conclusion made based on such findings and the recommendations there after. The study found that the regression equation relate the annual mortgage rates to annual GDP growth rate for the period 2003 for 2013. The y- intercept is actually the mean annual mortgage rate. The gradient (slope) is positive which means that mortgage interest rates and GDP growth rate are positively related although it is not significant.

5.2 Strength of relationship
From the values calculated of p-value, Pearson correlation coefficient r and coefficient of determination r² showed that the relationship is a weak one; however they showed consistent result on existence of a very weak relationship. The study therefore rejected the null hypothesis Ho that mortgage rates do not relate to GDP growth rate. After subjecting the parameters to significant test, the relation shown by the regression line is not significant. The mortgage interest rates relate with other factors more than the annual GDP growth rate.

5.3 Conclusion.
From the study’s findings it is evidenced that to some extend the GDP growth rate has little or no effect on the mortgage interest rates. The research also established the p-value is very small showing that change in GDP growth rate does not very much affect the mortgage interest rates; the regression line alone does not provide sufficient information on relation between the two variables hence it necessitated to carry out significant test which showed insignificant relation. The research finding shows that there are other factors that have greater influence on mortgage interest rates. These factors include inflation, price index, prime areas/urban, Cost of building materials etc.
5.4 Recommendation
The study recommends that other factors need to be investigated in order to assess the extent they influence the interest rates. The main goal is to have an effective mortgage interest policy and to reduce the volatility of interest rates. In the USA, President Roosevelt had to intervene when it was discovered no enough funds are available to mortgage investment and therefore established a company to provide funds and also to bring down interest rates. The interest rates in Kenya are higher than those charged in the USA, hence a need to establish the real factors that have a stronger impact on interest rates and how they can be controlled. The central bank of Kenya should apply stringent regulative policy on interest rates charged by mortgage firms so as to regulate mortgage rates spread. There should be a credit board or method to access the credibility worthiness of borrowers, many of mortgage firms do not get sufficient information on credit worthiness instead take advantage of lucky credit information and hike the interest rates to customers. In the USA, The Government introduced special credit cards that a customer earns bonga points every time he/she clears a loan. They rank customers in terms of bonga points and those with high bonga points enjoy reduced interest rates high value of loan than those with few bonga points.

5.5 Suggestion for further research
This study recommends further research should be done on the following areas:-
   i. Cost of land and to what extent it affects mortgage rates (land policy be checked)
   ii. Cost of building materials and how it can be reduced.
   iii. Availability of information about mortgage rates, which is sufficiently available to the public
   iv. Study to be carried out how USA, Canada and have managed to reduce interest rates and increased number of loan borrowers.
   v. Criteria of assessing credit worthless of customer is wanting

Finally the central bank should take the lead ensuring that a greater number of Kenyans are able to access the mortgage facilities.
5.6 Limitations of the study

The first limitation is the sample size, the data available especially from banking industry was from to 2003 to present. It was not possible to enlarge the sample outside 2003 to 2013. Again I visited 5 banks, and I was shocked that they have only data on current mortgage rates 2013 and 2014, no records were available for the other previous years. The Kenya bankers association had data for annual average rate from banking industry and it does not show changes of interest rates within a given year like are the case in the USA.
REFERENCES


Apps and Goucher,(1993); *The monetary and financial system institute of financial services,* chartered institute of Bankers publications.

Banking Act – Cap 488 of the laws of Kenya


Central Bank of Kenya; *Mortgage Finance of Kenya Survey Analysis*, October 2010


Doldes, M, J. (2006); *Sources of Funds for Mortgage Finance,* Journal of Housing Research Vol. PP 259-81


Hassler, O. and Walley, S; (2007); *Mortgage Liquidity Facilities,* Housing Finance International Volume xxiii No. 2.


Ngacha, S. W. (2013); Effect of interest rate volatility on Mortgage, unpublished MSc finance project, school of Business, University of Nairobi.


Omollo, O. M. (2012); Effects of Real Estate Finance Portfolio size on the size of stock performance of Commercial Banks listed on Nairobi Security Exchange, unpublished MSc University of Nairobi.


Weiers, R. M (1999); Introduction to Business Statistics; 2nd Ed, Liz Widdicombe, Fort Worth, Texas.


Website References


FTC: Mortgage Payments Sending reeling. (http://www.ftc.gov/bcp/edu/pubs/consumer/homes/rea04.shtm)
Appendix I: Mortgage Rates charged by Banks during the first quarter of 2014

<table>
<thead>
<tr>
<th>Number</th>
<th>Bank</th>
<th>% Mortgage rate the first quarter of 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Standard Chartered</td>
<td>10.9</td>
</tr>
<tr>
<td>2</td>
<td>Kenya Commercial Bank</td>
<td>12.9</td>
</tr>
<tr>
<td>3</td>
<td>Commercial Bank of Africa</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>Barclays Bank</td>
<td>14.9</td>
</tr>
<tr>
<td>5</td>
<td>National Bank</td>
<td>15.45</td>
</tr>
<tr>
<td>6</td>
<td>CFC Stanbic Bank</td>
<td>15.5</td>
</tr>
<tr>
<td>7</td>
<td>I and M Bank</td>
<td>15.5</td>
</tr>
<tr>
<td>8</td>
<td>Co-operative Bank</td>
<td>15.75</td>
</tr>
<tr>
<td>9</td>
<td>Housing Finance</td>
<td>16</td>
</tr>
<tr>
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</table>
Appendix II: R-code of linear regression model

> lm (A~B)
Call:
Lm (formula=A~B)
>mean(A)
>mean(B)
>Sd (A)
>Sd (B)
>cor(B,A)
>summary(lm (A~B))
Call:
Lm (formula=A~B)
Residuals

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